Distributed Impact Detection System, Phase II

Completed Technology Project (2005 - 2007)

Project Introduction

Automated impact detection and characterization on manned spacecraft has been an elusive goal due to the transitory nature of the detectable high-frequency signals. The proposed approach for this effort is to use large numbers of self-powered, miniaturized, "stick on" piezoelectric sensory nodes that are synchronized within a radio frequency network. Each node will continuously monitor an accelerometer, acoustic emission sensor, or PZT element for an impact event, such as the foam impact that caused the Columbia tragedy or a micro-meteor impact. When a programmable threshold is exceeded, a low-latency signal acquisition circuit will capture the event as a digital waveform for post-processing and impact characterization. In addition, autonomous collaboration and synchronization between nodes of the network will provide for accurate location determination through amplitude and time-of-arrival analysis. The innovative signal conditioning circuit design is capable of operation in the micro-watt range on average while constantly maintaining the capability to process and acquire ultrasonic acoustic signals. Additionally, the system will provide a general purpose hardware platform on which integrated structural health monitoring algorithms and sensing techniques can be implemented. Such performance can provide operating lifetimes of 10+ years on a single AA battery, or unlimited operation from scavenged power sources.

Anticipated Benefits

Potential NASA Commercial Applications: Potential Non-NASA applications include asset monitoring during shipment or transportation through the continuous monitoring and recording of shock events for both commercial and military equipment. Such a device could be placed in a shipping container and provide a history of any shock or high-g accelerations experienced including a timestamp and potentially location via GPS. Currently available commercial systems have very limited battery life and only provide an indication that an acceleration threshold has been exceeded with no way to characterize the event through signal analysis techniques.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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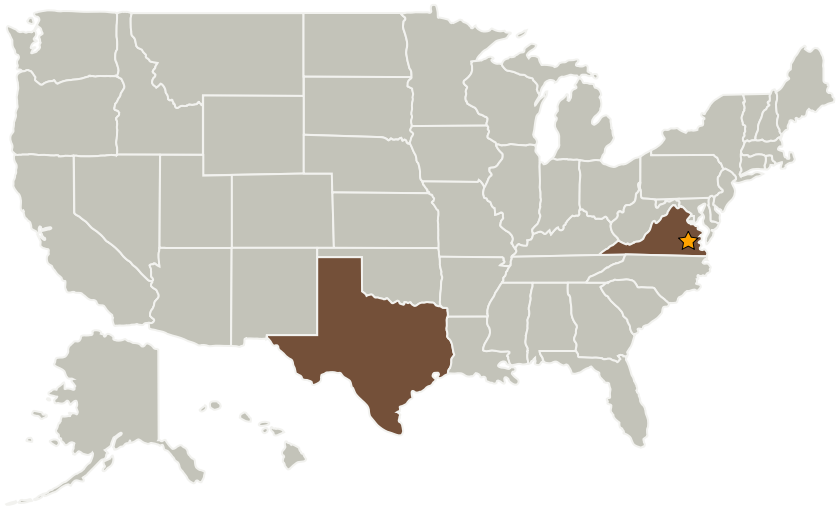
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Invocon, Inc.	Supporting Organization	Industry Veteran-Owned Small Business (VOSB)	Conroe, Texas

Primary U.S. Work Locations	
Texas	Virginia

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Michael Walcer

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.5 Structural Dynamics
    - TX12.5.3 Shock & Impact